

conductive pattern is surrounded by the sintered magnetic layers with a high density as a result of the no specific gap between the conductive pattern and the magnetic layers.

49. (New) A lamination ceramic chip inductor, according to claim 34, wherein the conductive pattern has edges which are not blurred.

50. (New) A lamination ceramic chip inductor, according to claim 37, wherein the at least one pair of magnetic insulation layers are sintered, and the conductive pattern is surrounded by the sintered magnetic layers with a high density as a result of the no specific gap between the conductive pattern and the magnetic layers.

REMARKS

Upon entry of the present amendment, claims 8-15 and 21-50 are pending in the present application. The newly submitted claims 39-50 depend directly or indirectly from claims 8, 12, 21, 25, 29 and 34. A total of 38 claims are now pending, the fee for 26 has been previously paid. Accordingly, the appropriate fee for 12 additional claims is included herewith.

The amendments and the newly submitted claims are supported in the specification and drawings as follows.

Support for the specific metals identified in claims 29 and 34 is found in the specification, for example, at page 41, lines 18-21.

The features of claims 8, 12, 21 and 25, that the claimed inductor comprises at least one fine, continuous conductive pattern, and of new claims 39, 41, 43, 45, 47 and 49, that the conductive pattern has edges which are not blurred, are supported in the specification for example at page 52, lines 17-27, and throughout the specification, which discloses use of a photoresist and electroforming. These features result from the use of a photoresist

and electroforming. The photoresist has high resolution, and the width of the conductive pattern can be adjusted with high precision. The electroforming allows formation of a conductive pattern which changes little or not at all in subsequent sintering or other thermal processing. Accordingly, a conductive coil having a larger number of turns can be formed in a smaller area than a conductor formed by printing. Such a larger number of turns in a smaller area means that the lines are fine, and the precise control of the width means that the lines are continuous, and the edges are not blurred by changes resulting from sintering and loss of binder or solvent. Applicants respectfully submit that this would be understood by a person of skill in the art. In the discussion below relating to the differences between the present invention and the cited prior art references, this point is further elaborated. The "fine" feature is explicitly mentioned at page 53, line 6.

Support for the feature of claims 40, 42, 44, 46, 48 and 50, that the at least one pair of magnetic insulation layers are sintered, and the conductive pattern is surrounded by the sintered magnetic layers with a high density as a result of the no specific gap between the conductive pattern and the magnetic layers, is supported at page 26, lines 7-14. The importance of this feature, and the recognition by those of skill in the art of this feature as a significant difference between the presently disclosed and claimed electroforming with photoresist as opposed to printing the conductive pattern, is discussed in more detail below.

Applicants respectfully submit that no new matter is added by the amendments and new claims.

Applicants respectfully request reconsideration and withdrawal of the rejections of the claimed invention, based on the foregoing amendments, the previously submitted Declaration, and the following remarks.

Interview Summary

Applicants' undersigned attorney sincerely thanks the Examiner for the courteous and helpful telephonic interview conducted on August 27, 2002. During the course of the

interview, Applicants' attorney and the Examiner discussed the proposed claim amendments submitted herein, including some discussion of the support for these features and of the distinctions between the claimed invention including these features and the cited prior art references. In addition, the features included in the newly submitted claims were briefly discussed. In particular, the features of the present invention resulting from the use of a photoresist and an electroformed conductive pattern were discussed. Applicants' attorney pointed out that the use of the photoresist and electroforming allows precise control of the lines of the conductive pattern of the claimed lamination chip inductor, which is much better than could be obtained by the prior art printing methods. Applicants' attorney also pointed out that the use of electroforming results in the "no specific gap" feature, since the metal of the conductive pattern is deposited in solid form and does not shrink upon sintering. This feature is in contrast to the prior art printing methods, in which a slurry consisting of both metal or metal precursor and a binder and/or solvent is used, and which, when sintered, necessarily shrinks, resulting in the formation of a gap between the conductive pattern and the surrounding insulation material. Applicants' attorney noted that this distinction was shown in detail in the Declaration by the inventor Mr. Uriu. During the interview, no agreement was reached on exact claim language. The Examiner indicated that any amendment would require a review of the cited references and a new search.

The foregoing constitutes Applicants' Interview Summary, in accordance with 37 CFR 1.133.

Rejection of Claims 8-15 and 21-38 Under 35 U.S.C. §103(a)

Claims 8-15 and 21-38 stand rejected as obvious over Tashiro et al, U.S. Patent No. 5,515,022 in view of Hirohashi JP 6-112047. Applicants traverse this rejection for at least the following reasons, in addition to the reasons of record, which are incorporated herein by reference.

With respect to the claimed thickness and width-to-thickness ratios, Applicants respectfully submit that the ranges disclosed by Tashiro et al at col. 6, lines 16-22, while possibly overlapping the claimed ranges, are not enabled. There is no teaching by Tashiro et al of which Applicants are aware of how one could obtain the claimed thickness and width to thickness ratios by the method of Tashiro et al. In the only Example, Tashiro et al form a conductive pattern having a width of 180 and a thickness of 10 (presumably microns), which is a ratio of 18, well outside the claimed range of 1 to less than 5. In addition to being not enabled, there is no suggestion in Tashiro et al of which Applicants are aware to select the claimed ratio of width to thickness for any reason.

As noted above, claims 8, 12, 21, 25, 29 and 34 have been amended herein. Applicants respectfully submit that the amended claims fully distinguish the present invention over the disclosures of the prior art, and in particular, over Tashiro et al and Hirohashi. As has been discussed previously, in all of the prior responses filed, the Declaration and in the telephonic interview on August 27, 2002, since Tashiro et al form a conductive pattern by printing, the features of the presently claimed invention simply cannot be obtained by Tashiro et al.

The amendment of claims 8, 12, 21 and 25, specifying the fine, continuous conductive pattern distinguishes the conductive pattern obtained by the present method over the pattern obtained by the printing method of Tashiro et al, because a printing method simply cannot obtain the fine, continuous conductive pattern of the present method, as discussed in more detail below. The amendment of claims 29 and 34 distinguishes the conductive pattern obtained by the present method over the pattern obtained by the printing method of Tashiro et al, because the use of a binder by Tashiro et al would necessarily result in some residue or ash being left behind in the sintering. The presently amended claim 29 and 34 specifies that the conductive pattern consists of metal selected from Ag, Au, Pt, Pd, Cu, Ni and alloys thereof. This language means that no binder residue or ash can be included in the conductive pattern of claims 29 and 34. This feature is enabled by and results from the electroforming, in which substantially pure metal

or alloy is laid down, free of any other contaminants, such as residue or ash from, e.g., a binder in a slurry of metal and binder used in a printing method.

While it is recognized that the electroforming and photoresist features are process limitations, Applicants respectfully submit that the structure obtained by such process differs significantly and patentably from the structure which would be obtained by the prior art methods, such as that of Tashiro et al. Specifically, the claim features, "fine, continuous", "not blurred", "no specific gap" and, most importantly, the thickness and width to thickness ratio, are obtained by the presently disclosed method, and could not be obtained by the method of Tashiro et al.

Applicants previously submitted the Declaration of Mr. Eiichi Uriu, one of the inventors of the presently disclosed and claimed invention. Applicants respectfully request the Examiner to again review the Declaration, in light of the presently submitted amendments and remarks. The Declaration includes details of experiments conducted by Mr. Uriu to observe the effects of producing conductive patterns by the electroforming process of the present invention and by the printing methods disclosed in Tashiro and Hirohashi. Results of these experiments are also detailed in the Declaration. These results are discussed below in relation to the above described features of the pending claims. These results demonstrate that the present invention would not have been obvious over these two references, since even if the references would be combined, the presently disclosed and claimed invention would not be obtained.

Thickness and Width to Thickness Ratio

Independent claims 8, 12, 21 and 25 include the feature of the conductive pattern having a thickness of 10 μm or more and a width to thickness ratio from 1 to less than 5, and have been amended to include the feature of a "fine, continuous" conductive pattern. Such a thickness and width to thickness ratio of the conductive pattern of the

present invention is a direct result of using an electroforming process as discussed in the Declaration in the last paragraph of section 1.2 and in section 2.2.

That is, as explained in the Declaration, no shrinkage occurs in the electroformed conductive pattern, such that the width of $40\text{ }\mu\text{m}$ and thickness of $20\text{ }\mu\text{m}$ is achieved in the final inductor structure.

On the other hand, the Declaration also shows that the above thickness and width conditions of the conductive pattern cannot be achieved by the printing methods of Tashiro and Hirohashi. That is, as explained in the Declaration, the printed conductive pattern first has a thickness of about $12\text{ }\mu\text{m}$ (which is a practical limit), however after sintering the thickness is reduced by about 40% to about $7\text{ }\mu\text{m}$ due to shrinkage.

Therefore, contrary to the disclosure in Tashiro et al that a thickness of $5\text{-}50\text{ }\mu\text{m}$ is possible, the declaration clearly shows that this is not the case in practice, where the final thickness is less than $7\text{ }\mu\text{m}$. With a width of about $50\text{ }\mu\text{m}$, the width to thickness ratio of the prior art is about 7 (i.e., $50\text{ }\mu\text{m}/7\text{ }\mu\text{m} \approx 7$). Thus, Tashiro and Hirohashi do not teach or suggest the claimed invention in relation to the thickness ($10\text{ }\mu\text{m}$ or more) and width to thickness ratio (1 to <5) features thereof.

With respect to the fine, continuous, and non-blurred features (the latter included in newly submitted claims 39, 41, 43, 45, 47 and 49), these features directly result from the use of a photoresist to define a pattern which is used in electroforming the conductive pattern. As would be understood by a person of skill in the art at the time of filing the priority application, use of a photoresist allows control of critical dimensions down to less than $1\text{ }\mu\text{m}$. Of course, today, critical dimensions are much smaller, but at the time of filing the priority application, critical dimensions were commonly at least as small as $0.35\text{ }\mu\text{m}$. See, for example, col. 2, line 62 of U.S. Patent No. 5,705,321, the priority application for which was filed Sept. 30, 1993. Therein is disclosed that $0.35\text{ }\mu\text{m}$ is regularly obtained, and discloses a method to obtain much lower critical dimensions

by use of a photoresist. Thus a person of ordinary skill in the art, at the time of filing the present application, would have readily understood and appreciated that use of a photoresist and electroforming a conductive pattern would result in a fine, continuous conductive pattern which has edges not blurred. See also claims 10, 14, 23, 27, 31 and 36, which specify that the conductive pattern has a shape of a straight line.

As disclosed in the present specification, and recited in the claims, the claimed lamination chip inductor includes the conductive pattern having a width of at least 10 μm , and in some embodiments, a width of 50 μm or more. As known in the art, a 0.35 μm critical dimension, i.e., tolerable variation, in the width of a line ranging from 10 to 50 μm , means that the line edges are fine, continuous, not jagged, and are not blurred, rough or uneven. Given that the lines are not jagged and not blurred, they are surely continuous, since this level of control would provide lines with small variations in width and therefore with no discontinuity.

Applicants respectfully submit that a person of ordinary skill in the art would easily understand that a critical dimension at least as low as 0.35 μm , could not be obtained by a printing method and therefore the claimed features would not be obtained by the method of Tashiro et al and Hirohashi singly or in combination. Stated another way, a printing method is a macroscopic method, while a photoresist method is a microscopic method. The macroscopic method would lead to blurred lines which are not fine, and, if attempted to be used to make fine lines, would likely not be continuous.

A prerequisite for a case of obviousness is that the Examiner must show that the asserted combination of prior art references teach all of the limitations of the allegedly obvious claims. In the present case, the Declaration of Mr. Uriu, and the foregoing points with respect to the fine, continuous and non-blurred conductive pattern resulting from electroforming using a photoresist, rebuts any such showing.

Accordingly, independent claims 8, 12, 21 and 25, and the claims dependent thereon, would not have been obvious over the asserted combination of Tashiro and

Hirohashi, since as shown by the Declaration of Mr. Uriu, even if these references were combined, they do not include all of the limitations of the claimed invention.

No Specific Gap

Independent claims 21, 25, 29 and 34, and the claims dependent thereon, include the feature of the conductive pattern having no specific gap. In the final Office Action the Examiner contended that the applicant had not specified what is meant by this feature. Applicants respectfully submit that what is meant by this feature would be clear based on the disclosure of the specification. As shown in the following, the present invention results in the formation of no specific gap, but the prior art does result in the formation of a specific gap. This feature distinguishes the claimed invention over the prior art.

As previously submitted, Applicants respectfully assert again that the Declaration shows what is meant by this term which is used in the specification of the present application. Specifically, the "no specific gap" feature of the present invention is a direct result of using an electroforming process as discussed in the declaration in section 2, and would not be obtained by the methods of the cited references.

That is, as explained in the Declaration in the electroforming process of the present invention no specific gap is formed in the electroformed conductive pattern, since electroforming involves the formation of the pattern by metal plating, without the use of any constituent materials which evaporate or are otherwise lost as a result of the sintering performed, such that no shrinkage occurs.

On the other hand, the Declaration also shows that a specific gap is formed in the printing methods of Tashiro and Hirohashi due to shrinkage of the conductive pattern caused by the evaporation of the binder resin and the solvent in the conductive paste making up the conductive pattern as a result of the sintering. The Examiner is specifically referred to the figures in the Declaration which unequivocally show that a specific gap is obtained by the Tashiro et al/Hirohashi combination, but no gap is formed between the conductor and the surrounding insulator made in accordance with the present invention.

The Declaration further explains that such a specific gap is undesirable, since it renders the printed conductive pattern susceptible to contaminants, such as water or plating solvent, which may become present in this gap and which can change the characteristics, such as the resistance or impedance, of the printed conductive pattern, therefore changing the characteristics of the inductor formed using this printed conductive pattern.

Therefore, as shown by the facts in the Declaration, even if a specific gap is not shown in the drawings of Tashiro et al and Hirohashi, such a gap does in fact exist due to the printing methods used by Tashiro et al and Hirohashi. It is possible that Tashiro et al failed to appreciate that a gap was present, or if they did, they failed to appreciate the drawback of such a gap. Thus, Tashiro et al and Hirohashi also do not teach or suggest the claimed invention in relation to the no specific gap feature thereof.

Accordingly, independent claims 21, 25, 29 and 34, and the claims dependent thereon, would not have been obvious over the asserted combination of Tashiro et al and Hirohashi, since as shown by the Declaration of Mr. Uriu, even if these references were combined, they do not yield all of the features of the present invention, as specified in these claims.

In addition, the newly submitted claims 40, 42, 44, 46, 48 and 50 specify that in the embodiments having magnetic insulating layer which are sintered, the conductive pattern is surrounded by the sintered magnetic layers with a high density and no specific gap between the conductive pattern and the magnetic layers (claims 40 and 42), or where appropriate (claims 44, 46, 48 and 50), the conductive pattern is surrounded by the sintered magnetic layers with a high density as a result of the no specific gap between the conductive pattern and the magnetic layers. Here again, the sintering of the structure of Tashiro et al would result in formation of a density-lowering specific gap between the conductive pattern and the insulation layers. In the present invention, by contrast, as a result of the electroforming, no specific gap is formed and the conductive pattern is surrounded by the sintered insulation layers at a high density.

For these additional reasons, Applicants respectfully submit that the claimed invention fully distinguishes over the disclosures of Tashiro et al and Hirohashi.

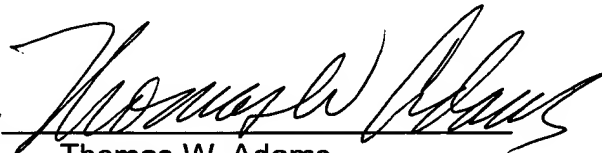
Conclusion

For all the foregoing reasons, Applicants respectfully submit that the presently pending claims patentably distinguish over the cited combination of references. The Examiner is respectfully requested to reconsider and withdraw the rejection of Applicants' claims.

In the event issues remain in the prosecution of this application, Applicants request that the Examiner telephone the undersigned attorney to expedite allowance of the application. Should a Petition for Extension of Time be necessary for the present Reply to the outstanding Office action to be timely filed (or if such a petition has been made and an additional extension is necessary) petition therefor is hereby made and, if any additional fees are required for the filing of this paper, the Commissioner is authorized to charge those fees to Deposit Account #18-0988, Docket No. YAMAP0347USB.

Respectfully submitted,
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APPENDIX

The amended claims shown above have been amended as follows:

8. (Twice Amended) A lamination ceramic chip inductor, comprising at least one conductive pattern, the at least one fine, continuous conductive pattern having a thickness of 10 μm or more and a width to thickness ratio from 1 to less than 5.

12. (Twice Amended) A lamination ceramic chip inductor, comprising at least one fine, continuous conductive pattern formed by an electroforming process using a photoresist, the at least one conductive pattern having a thickness of 10 μm or more and a width to thickness ratio from 1 to less than 5.

21. (Amended) A lamination ceramic chip inductor, comprising at least one fine, continuous conductive pattern formed between at least one pair of insulation layers so as to have no specific gap between the at least one conductive pattern and the at least one pair of insulation layers, the at least one conductive pattern having a thickness of 10 μm or more and a width to thickness ratio from 1 to less than 5.

25. (Amended) A lamination ceramic chip inductor, comprising at least one fine, continuous conductive pattern formed by an electroforming process using a photoresist, the at least one conductive pattern having a thickness of 10 μm or more and a width to thickness ratio from 1 to less than 5,

wherein the at least one conductive pattern is formed between at least one pair of insulation layers so as to have no specific gap therebetween.

29. (Amended) A lamination ceramic chip inductor, comprising at least one conductive pattern formed between at least one pair of insulation layers so as to have no specific gap between the at least one conductive pattern and the at least one pair of insulation layers, the at least one conductive pattern consisting of metal selected from the group consisting of Ag, Au, Pt, Pd, Cu, Ni and alloys thereof.

34. (Amended) A lamination ceramic chip inductor, comprising at least one conductive pattern formed by an electroforming process using a photoresist, wherein the at least one conductive pattern is formed between at least one pair of insulation layers so as to have no specific gap therebetween, the at least one conductive pattern consisting of metal selected from the group consisting of Ag, Au, Pt, Pd, Cu, Ni and alloys thereof.